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A STUDY OF THE CARYAEFOLIELLA GROUP OF THE FAMILY COLEOPHORIDAE (LEPIDOPTERA) *

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Until recently I have been applying the name *caryaeoliella* Clem. to the common species of eastern Ontario, the cases of which are found on hickory (*C. glabra* and *C. cordiformis*) and which I mentioned and figured in one of my previous papers (1933, Can. Ent., LXV, 161, Pl. X, figs. 19-21). However in early June, 1944, Mr. T. N. Freeman collected a number of cases on shag-bark hickory (*C. ovata*) at Pt. Rowan in southern Ontario which produced adults very similar in color and maculation, it is true, to our eastern Ontario species, but differing markedly in male genitalic characters. This has necessitated a careful study of the group—which includes species 15-22 of Heinrich's revision (1924, Mem. 68, Corn. Agr. Exp. Sta., 211)—both from the standpoint of nomenclature and of genitalic characters; as a result excellent characters have been found in the male genitalia whereby the superficially very similar species may be separated and, furthermore, an apparent and rather unfortunate misapplication of several of the names has been indicated.

As noted by Heinrich the section comprises moths 'with fore wings golden to dark brown; costa white, otherwise unmarked'. Based on genitalia two groups of species are indicated. In the one group the male genitalia show a *simple* recurved, hook-like extension of the sacculus and the aedeagus is variably armed with spines or teeth; the female genitalia possess a large, *raised, circular* ostium which can generally be easily observed without removing the abdomen. In the second group the hook-like extension of the sacculus in the male genitalia shows a small, *accessory spine* or tooth, situated subapically, and the aedeagus is unarmed; in the female genitalia the ostium opening is not nearly so raised or obviously circular and is generally concealed by the overlapping integument of the preceding segment. The larval cases are of the 'cigar-case' type with flatly compressed apices but frequently show distinctive characteristics according to their position on the leaf-surface. In the majority of species the case is semi-upright on the leaf—what Heinrich terms 'mouth deflected to 45 degrees' and what European workers designate as 'mouth opening 4-5'; in a few instances, however, (*corylifoliella* Clem., *alniella* Heinr. and an undescribed species on black walnut) the case rests practically flat on the leaf-surface with 'mouth deflected to 90 degrees' or 'mouth opening I'.

In the spring of 1945 a strong and quite successful effort was made to augment our series of as many of the species of the group as occurred in the Ottawa region by a careful search for cases on the various food-plants involved. In consequence it has been possible in many instances to study good series of genitalic slides and differentiate between individual variation and good specific characters. In this connection I must express my indebtedness to Dr. A. Braun of Cincinnati who, with her usual generosity, has supplied material and collecting notes of several species I was unable to otherwise obtain. I have thus been enabled to study the genitalia of what appears to be authentic material of all the species under consideration with the exception of *alniella* Heinr. which—as it was originally stated to possess the flat type of larval case—I had evidently misidentified in my 1933 paper.

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I realize that the present paper is not entirely satisfactory as I have, unfortunately, been unable personally either to examine the actual holotype specimens of several species or to get information regarding their genital structure. However, Mr. T. N. Freeman, on a recent visit to Philadelphia and Washington, has examined certain of these types and has been able to confirm my identifications in most instances.

KEY TO SPECIES BASED ON MALE GENITALIA*

1. Terminal hook-like process of sacculus simple.....2
 Terminal hook-like process of sacculus with small preapical tooth on inner edge 5
 Terminal hook-like process of sacculus with tooth near base on outer edge *alnivorella* n. sp.
2. Aedeagus armed with strong ventro-basal spine 3
 Aedeagus without such spine 4
3. Apical hook of sacculus moderately bent dorsad, not attaining dorsal margin of clasper; aedeagus abruptly broadening beyond anellus and with preapical spine on left side *laticornella* Clem. (syn. *caryaefoliella* Clem.)
 Apical hook of sacculus strongly bent dorsad, extending beyond costal margin of clasper; aedeagus gradually broadened at base, beyond anellus and without preapical spining *corylifoliella* Clem.
4. Aedeagus with long, bifurcate, dorsal spine on right side arising from median area; curve of sacculus-hook follows outer margin of clasper *lentella* Heinr.
 Aedeagus with single, long, dorsal spine on right side; sacculus-hook more strongly recurved and crossing dorsal margin of clasper *juglandella* n. sp.
 Aedeagus without strong dorsal spines; with 1-3 minute erect teeth on lateral edges in median section (variable number and often obsolescent) *ostryae* Clem., syn. *rufoluteella* Cham., *carpinella* Heinr..
5. Tooth of sacculus-hook close to apex; aedeagus very short *ulmifoliella* n. sp.
 Tooth of sacculus-hook further basad; aedeagus longer *umbratica* Brn., *comptoniella* McD., *betulivora* n. sp.

Coleophora laticornella Clem.

- Coleophora laticornella* Clem., 1860, Proc. Acad. Nat. Sci. Phil., 5; Busck, 1903, Proc. Ent. Soc. Wash., V, 192 (as syn. *limosipennella* Dup.).
Coleophora caryaefoliella Clem., 1861, Proc. Ent. Soc. Phil., I, 78; Chambers, 1878, Can. Ent., X, 112; Braun, 1914, Jour. Cin. Soc. N. Hist., XXI, 159; Heinrich in Forbes, 1924, Mem. 68, Corn. Agr. Exp. Sta., 211 (new synonymy).

Following Busck, who examined Clemens' type at Philadelphia, *laticornella* has been listed as a synonym of the supposedly introduced European elm-feeder, *limosipennella* Dup. Such an association is quite understandable as Clemens' original description would apply almost equally well to any species in the group, and, at the time the type was examined, Busck could scarcely have realized either the close superficial similarity of the species or indeed the fact that more than one species was involved.

The original description of *laticornella* fits in excellently with our series of Pt. Rowan specimens, bred from *Carya ovata*, rather better, indeed, than it does with specimens of the elm-feeder in our collection from southern Ontario. Chambers (Can. Ent., X, 114) determined cases secured on *C. ovata* (*C. alba*) as *caryaefoliella* and specimens received from Dr. Braun of Cincinnati, Ohio, bred from hickory, match our Pt. Rowan series in genitalia and indicate that this is the hickory-feeding species which would, in all probability, occur in the region where Clemens collected. The fact that such a careful observer as Clemens makes no mention of any cases found on elm in his vicinity is a further indication that,

**alniella* Heinr. has been omitted.

in his time at least, an elm-feeding species did not occur in eastern Pennsylvania; usually where it does occur it is so numerous as to be one of the most noticeable species of the group. To my mind therefore it seems more probable that the name *laticornella* was based on an adult of a hickory-feeding species, the cases of which were later found by Clemens and designated *caryaefoliella*; the latter name would thus become a synonym, and as such I propose to treat it until evidence to the contrary is produced; an examination of the genitalia of Clemens' type would definitely clinch the matter and it is to be hoped that this may be done by some future worker, owing to the economic importance of the species.*

Male Genitalia. (fig. 1). (Specimens examined: 1 ♂, Cincinnati, Ohio; 5 ♂, Port Rowan, Ont.). Small. Sacculus with its ventral margin rounding gently into the caudal margin which terminates in a simple, pointed, hook-like process, reaching about three-quarters of the way across the clasper and bending slightly inward apically. Clasper short and stubby, extending only slightly beyond sacculus. Valvula moderately large and rounded apically; setose. Gnathos narrowly oval, semiupright. Aedeagus a short, broad, cylindrical tube, weakly chitinized on its dorsal surface and bending gently ventrad apically; it is sharply expanded at its base into a bulb-like section after which the sides run parallel to near apex, converging then to a blunt point; a strong subbasal spine is present on the ventral surface, slightly to the right of the median line and on the left side subapically there is a sharp, flat tooth or spine. The vesica contains in its apical section a short, fine, very weakly chitinized strip which seems to consist of fine spines more or less conjoined dorsally.

Female Genitalia. (Pl. I, fig. 1). (Specimens examined: 3 ♀, Port Rowan, Ont.). Genital plate convex, somewhat broader than high, the sloping sides rounded gently inwardly at caudal end; caudal margin slightly excavated centrally and feebly setose. Ostium a broad, semicircular, raised opening about the centre of the plate, leading into an equally broad, weakly chitinized, initial portion of the ductus bursae, the parallel sides of which extend for a short distance beyond the cephalic margin of the plate; this is followed by a short, finely spiculate membranous section of equal width after which the tube narrows somewhat and terminates shortly in the neck of a long, oval bursa which is furnished with a large signum in the form of a curved pointed hook, arising from a broad chitinous plate.

Larval Case. Deep brown, smooth, cylindrical, with mouth depressed to about 45 degrees, the apex flatly compressed, slightly expanded laterally and with a straight terminal edge. The length of individual cases varies from 5-8 mm. and they are apparently cut from the central portion of the leaf as none of those before me show any signs of dorsal serrations; they can scarcely be distinguished except by size from those of our eastern Ontario bitter-nut feeder or from the *Ostrya*-feeder. The moth emerges in late June, fully two or three weeks earlier than that of the elm-feeder.

Food-plant. *Carya ovata* (Mill.).

***Coleophora corylifoliella* Clem.**

Coleophora corylifoliella Clemens, 1861, Proc. Ent. Soc. Phil., I, 79, Heinrich in Forbes, 1924, Mem. 68, Corn. Agri. Exp. Sta., 212.

The name *corylifoliella* was based on immature cases observed in the fall on *Corylus*. In the original description Clemens states that the mouth of the case is *not deflected* but Heinrich asserts 'mouth deflected to 90 degrees'. Possibly immature cases vary from the mature ones in this respect. Dr. Braun informs me (*in litt.*) that she has bred two males and two females from cases on *Corylus* which agree with Heinrich's description and that the final case is cut from the

*Since this was written Mr. Freeman has examined the female type at Philadelphia and confirms the present identification.

leaf-margin. One of these males from Powell Co., Ky. (without case), has been kindly presented to our collection and from it I have made a genitalic slide; this agrees with a slide made by me last November of a male specimen in the Museum of Comparative Zoology, Cambridge, Mass., from Falls Church, Va., donated and determined as *corylifoliella* by Carl Heinrich. These two male specimens are the only ones seen by me; the species has not been found in Canada; it appears in early June.

Superficially *corylifoliella* looks like a very small *laticornella* but differs in male genitalic characters.

Male Genitalia. (fig. 2). Of the same general type as *laticornella*. The apical hook of the sacculus, however, is thinner, more recurved and extends beyond the dorsal margin of the clasper. The aedeagus, while possessing the ventro-basal spine found in *laticornella*, lacks the subapical one; it broadens gradually, not abruptly, from the base and is relatively somewhat longer. The armature of the vesica appears similar to that of *laticornella*.

Food-plant. *Corylus*.

***Coleophora alniella* Heinr.**

Coleophora alniella Heinrich, 1914, Proc. Ent. Soc. Wash., XVI, 68; 1924, Mem. 68, Corn. Agr. Exp. Sta., 121.

As already indicated I have been unable to examine the male genitalia of this species, the only specimen seen being a female in the Museum of Comparative Zoology, Cambridge, reared on *Alnus* from Falls Church, Va. (1914), and determined and donated by Carl Heinrich. According to my notes it has a paler ochreous forewing than *corylifoliella* with more whitish suffusion at base. Heinrich, in his revision, hints that it may be the same species as *corylifoliella*, stating that it has the same type of case (i.e. flat on the leaf surface) and only differing in the adult in the somewhat less dark and less distinctly marked brown annulations on the antennae. However, in view of the difference of the food-plants, I believe the species will prove a good one when it is possible to examine the male genitalia. Mr. Freeman reports that the Holotype at Washington is a female and that two male Paratypes lack abdomens; it was not feasible at the time to make a genitalic slide.

***Coleophora juglandella* n. sp.**

Hardly separable superficially from other small species in the group, such as *ostryae*. Head and basal joint of antenna creamy, with faint brownish tinge. Palpi porrect with third joint scarcely upturned and little trace of apical tuft on second joint, creamy inwardly, brownish outwardly. Antennae annulate for entire length with brown and white. Primaries very deep brown with a narrow, sharply defined, white costal margin extending as far as the costal fringes; these concolorous, other fringes deep smoky with scattered smoky scaling at base. Hindwings and fringes deep smoky.

Male Genitalia. (fig. 3). Of the usual type. Simple apical hook of sacculus well recurved and extending just over the dorsal margin of the clasper. Clasper narrow and only slightly produced beyond the sacculus-hook. Aedeagus short and bent strongly ventrad in its distal section, furnished with a long, pointed, dorsal spine, arising on the right side in the mid-section. Armature of vesica much as in the preceding species.

Female Genitalia. As far as can be judged from the single available slide they are very similar to those of *lentella*. The genital plate is narrower, being much broader than high and the ostium opening is less strongly chitinized. The initial, chitinized portion of the ductus is of the same general appearance as that of *lentella* but shorter and with weaker chitinization; it also bends more to the right. The hook of the signum is very fine and the basal plate more extended than in *lentella*.

Larval Case. Short and chunky, rather rough, with mouth deflected to nearly 90 degrees and the flatly compressed apex slightly expanded and feebly rounded. Length 5 mm. Rests on the upper side of the leaf when pupating.

Food-plant. *Juglans nigra* L.

Holotype — ♂, Port Rowan, Ont., June 3, 1944 (T. N. Freeman) (From case on Black Walnut); No. 5621 in the Canadian National Collection, Ottawa.

Allotype — ♀, same data.

***Coleophora lentella* Heinr.**

Coleophora lentella Heinrich, 1915, Ins. Insc. Mens., III, 143, *id.*, 1924, Mem. 68, Corn. Agr. Exp. Sta., 212.

Haploptilia lentella McDunnough, 1933, Can. Ent. LXV, 163, Pl. X, fig. 18 (case).

Up to 1945 my identification of this species was based on the male specimen and case mentioned in my 1933 paper, together with another male specimen with similar genitalia from Severn, Ont. In the spring of 1945, however, careful search of yellow birch trees in the eastern outskirts of Ottawa produced about a dozen cases from which in due course 1 ♂, 3 ♀, emerged, the remainder being parasitized.

Not having studied the type my identification was more or less tentative, but as the specimens before me matched quite well with Heinrich's description I felt reasonably certain in placing them under this name, especially in view of the similarity of larval food-plant; Mr. Freeman, after study of the type and its genitalic slide, confirms the identification. The adults are very similar in size and coloration to *ostryae* Clem. but are best distinguished by characters in the male genitalia, being in this respect closest to *juglandella*.

Male Genitalia. (fig. 4). (Specimens examined: 2 ♂, Ottawa, Ont., 1 ♂, Severn, Ont.). The recurved terminal sacculus-hook follows along the caudal margin of the rather narrow clasper, reaching practically to the dorsal edge of same. The aedeagus broadens gently in the basal half, the sides being convex; in the apical half the organ narrows, the sides being parallel and there is a decided downward bend; the apical edge is outwardly oblique from left to right, terminating in more or less of a point on the right side. Just beyond the bulging basal section a *prominent bifurcate spine* arises on the right side. The armature of the vesica seems very similar to that of the other members of the group.

Female Genitalia. (Pl. I, fig. 2). (Specimens examined: 2 ♀, Ottawa, Ont.). The genital plate is convex, the sides sloping rather rapidly; the lateral edges are rounded caudally into the posterior margin which shows a faint median concavity and is moderately setose. The large, raised, circular ostium is situated in the central area of the plate; the initial portion of the ductus bends somewhat to the right and is better chitinized than that of other species in the group; it is also relatively longer, breaking up in its cephalic section into two chitinized tongues of which that on the left side is considerably the longer. Following this is the usual short, spiculate, membranous area, out of which a narrower, membranous tube leads into the long, oval bursa. The signum consists of a well-developed curved spine on a chitinous base that is much less expanded than usual.

Larval Case. Deep gray or black-brown, rather chunky, 5-6 mm. long; in general fairly smooth but the dorsal edge mostly shows a few serrations, the case being evidently formed from the outer margin of the leaf; apical section flatly compressed with very slightly curved outer margin. The case rests rather flatter on the leaf than do those of *ostryae* and *laticornella*, the mouth being deflected to about 60°. When found in early May the larvae were in their final cases so apparently must hibernate nearly full-grown; they feed up very slowly, pupate in June and emerge as adults in early July.

Food Plants. *Betula lenta* (according to Heinrich); *Betula lutea* (at Ottawa).

***Coleophora ostryae* Clem.**

Coleophora ostryae Clemens, 1861, Proc. Ent. Soc. Phil., I, 79; Braun, 1914, Jour. Cin. Soc. Nat. Hist., XXI, 159; Heinrich, in Forbes, 1924, Mem. 68, Corn. Agr. Exp. Sta., 211.

Haploptilia ostryae McDunnough, 1933, Can. Ent., LXV, 162, Pl. X, fig. 5.

Coleophora rufoluteella Chambers, 1874, Can. Ent., VI, 129; *id. op. cit.*, X, 112; Braun, 1914, Jour. Cin. Soc. Nat. Hist., XXI, 159; McDunnough, 1945, Can. Ent. (1944) LXXXVI, 238.

Coleophora carpinella Heinr., 1914, Proc. Ent. Soc. Wash., XVI, 67; 1924, Mem. 68, Corn. Agr. Exp. Sta. 211. (*new synonymy*).

Haploptilia caryaefoliella McDunnough (*nec* Clemens) 1933, Can. Ent., LXV, 161, Pl. X, figs. 19-21.

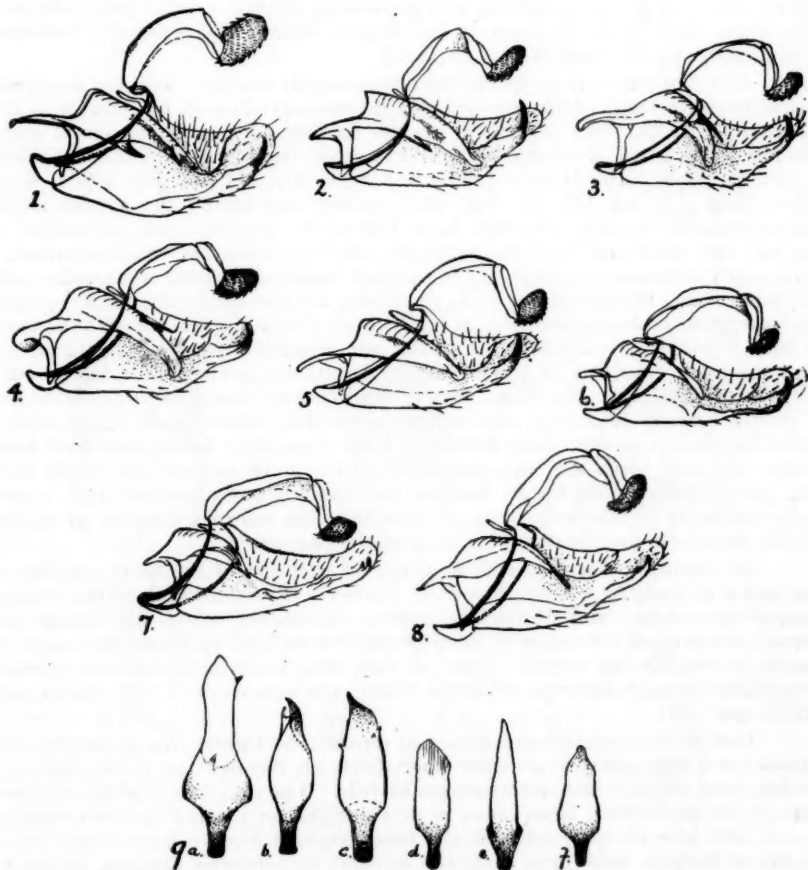
Very similar in general appearance to *laticornella* (*caryaefoliella*) but considerably smaller and quite distinct on genitalic characters.

Apart from the series bred from cases on *Ostrya* and *Carya* at Bobcaygeon, as noted in my 1933 paper, we obtained in 1945 long series of adults from cases on the same food-plants, collected in the Ottawa region where they were quite abundant, especially those on *Ostrya*. We have also secured for the first time a good series of specimens from cases on *Carpinus* which before this year had been overlooked, probably due to the rather localized occurrence of blue beech in the district. After a study of numerous genitalic slides, both male and female, made from all three of our series, I can see nothing that would indicate that more than a single species is involved. It was also noted at the time of rearing that the *Ostrya*-feeders would eat *Carpinus* sparingly but no experiments of this sort were attempted with the *Carya*-feeders which, it is quite possible, have become more fastidious in their choice of food. However as, to my mind, no particular purpose is served at the present time in designating a number of so-called biological races, I am adopting the synonymy as indicated above and treating the whole as a single species with a varied number of food-plants. It might be noted in this connection that single cases occurring—perhaps accidentally—on oak and basswood produced this same species of moth. Besides a female paratype of *carpinella* Heinr. in our collection we possess a pair of specimens from Cincinnati, Ohio, donated by Dr. Braun; these agree in genitalia with our Ottawa series.

Male Genitalia. (fig. 5). (Specimens examined: 1 ♂, Cincinnati, Ohio, 4 ♂, Aylmer, Que., from *Carpinus*; 1 ♂, Cincinnati, Ohio, 2 ♂, Bobcaygeon, Ont., 4 ♂, Ottawa region, from *Ostrya*; 4 ♂, Bobcaygeon, Ont., 6 ♂, Ottawa region from *Carya* (probably *cordiformis*). Of the same general type as *laticornella* but throughout more slender. Terminal hook of sacculus attaining dorsal margin of clasper and only moderately recurved. Clasper narrower than in *laticornella* and projecting slightly further beyond the sacculus-hook. Aedeagus rather short, broad at base narrowing somewhat apically and bending gently ventrad; the terminal edge oblique from left to right, due to the greater length of the right side. The lateral edges, especially on the right side, tend to be slightly raised and terminate at points considerably before the apex in small notches which occasionally are enlarged, notably on right side, to the semblance of minute teeth. A very variable armature of small teeth is found in the median area of which an upright tooth on the right side, somewhat cephalad of the middle, is the most constant; at times, however, this is absent and in other cases it may be augmented by one or two approximate smaller teeth. On the left side one or two minute teeth frequently occur in the median area just interior to the edge; there may further be an upright tooth on the edge itself similar to that of the right side; in other cases, all teeth are obsolete. Hardly any two specimens are exactly similar in armature and all manner of combinations exist, such variation occurring in each of the series from any one food-plant. Vesica armature similar to that of the other species.

Female Genitalia. (Pl. I, fig. 3). (Specimens examined: 1 ♀, Paratype, College Park, Md., 3 ♀, Aylmer, Que., from *Carpinus*; 1 ♀, Bobcaygeon, Ont.,

3 ♀, Ottawa region, from *Ostrya*; 1 ♀, Bobcaygeon, Ont., from *Quercus*; 1 ♀, Bobcaygeon, Ont., 4 ♀, Ottawa region, from *Carya* (probably *cordiformis*). Very similar to those of *laticornella*. Genital plate scarcely wider than high, convex, with sloping sides, the lateral edges gently rounded caudally, the caudal edge slightly excavate in median area and feebly setose. Ostium large, in central portion of plate, the cephalic edge somewhat more semicircular than that of *laticornella* and relatively broader; it is very weakly chitinized and somewhat contracted below the rim. The short, initial portion of the ductus is also very feebly chitinized, this area extending on the left side slightly beyond the cephalic edge of the genital plate and on the right side usually only as far as this edge, terminating in both instances in a small patch of heavier chitin which appears to be a quite characteristic feature. The distal portion of the ductus and the bursa with its signum much as in *laticornella*.



Male Genitalia (left clasper removed) of 1, *Coleophora laticornella* Clem.; 2, *C. corylifoliella* Clem.; 3, *C. juglandella* n. sp.; 4, *C. lentella* Heinr.; 5, *C. ostryae* Clem.; 6, *C. alnivorella* n. sp.; 7, *C. ulmifoliella* n. sp.; 8, *C. betulivora* n. sp., 9, Aedeagus (dorsal view) of a, *C. laticornella*; b, *C. lentella*, c, *C. ostryae*; d, *C. ulmifoliella*, e, *C. betulivora*, f, *C. alnivorella*.

Larval Case. Deep brown in the *Ostrya* and *Carpinus* feeders, paler, more ochreous brown, in the *Carya* ones; smooth, cylindrical, flattened apically, the sharp terminal edge being almost straight. Dorsal edge very rarely serrate as the final case is made from the interior portion of the leaf. Mouth deflected to about 45° or less, length about 6 mm. The final case is cut after feeding starts in the early spring; when feeding the case is attached to the underside of the leaf but for pupation the larva generally fastens the case to the upperside. The moths emerge in the last week of June or in early July, somewhat later in the case of the *Carya*-feeders.

Food Plants. *Ostrya*, *Carpinus*, *Carya cordiformis* and probably *C. glabra*.

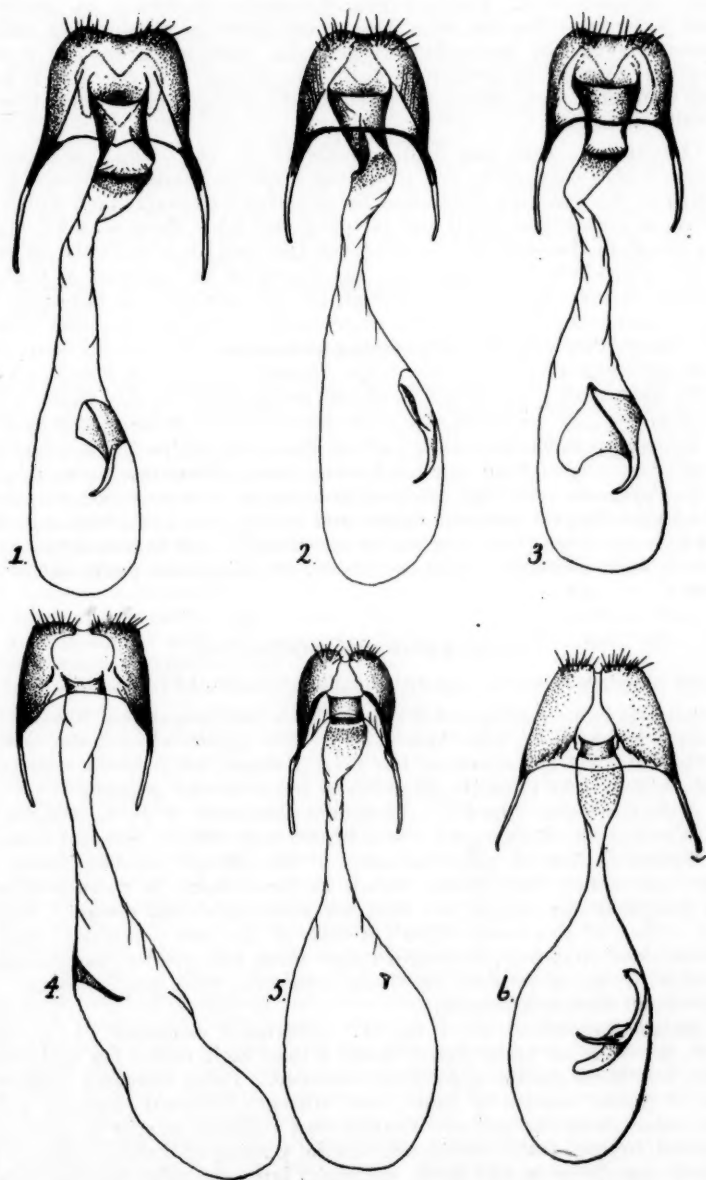
With the above species we bring to a close the group in which the hook-like projection of the sacculus is simple and unarmed. In the following species this hook either shows a small, dorsal, subapical tooth or a tooth-like projection on ventral margin nearer base. In adults the color of the forewings is mostly paler than that of the preceding group, tending toward a light golden brown; the white area along the costa is less sharply defined and generally broadens considerably in the basal area of the wing.

Our North American species have been largely confused with the European *limosipennella* Dup. which was—possibly erroneously—limited by Barasch (1934, Deutsch. Ent. Ztschrft., 37) to the species feeding on elm in the larval stage. An elm-feeder was first recorded in North America from Prospect Park, Brooklyn, and adjacent areas by Hoover (1904, Ent. News XV, 54) and Felt (1905, N. Y. Mus. Mem., (8), 1, 167, Pl. 34); both authors considered the species to be *limosipennella*, recently imported from Europe on English elms. However, as far as I can make out from the extremely involved literature which contains, I fear, many erroneous applications of original names, European authorities such as Stainton and Heinemann agree in describing the case of the elm-feeder (which they designate as *limosipennella*) as lying nearly flat on the leaf-surface; the larva is fully fed in July and hibernates in the case, pupation occurring in the spring and the moth emerging in June. Similar habits are ascribed to a birch-feeder by Waters (1927, Ent. Mo. Mag., 182) under the same name, *limosipennella*, but I should hesitate to accept the correctness of this identification until careful genitalic studies of specimens definitely bred from both food-plants had been made; elm and birch are such dissimilar plants as to warrant the belief that the same species would hardly feed on both and it seems possible that superficial similarity of wing-coloration in the adults has led to a lumping of species which eventually may be separable on genitalic characters.

In passing it might be well to draw the attention of European workers to the fact that, judging by the remarks of Fischer v. Roesslerstamm at the conclusion of his volume and Herrich-Schaeffer's statements when illustrating the species, the original specimens of *limosipennella* were bred by Mann from cases on maple in the Vienna region. Some of this same material apparently reached Duponchel through Parreyss, a Vienna dealer, (see statement in 1844, Catal., pp. XXIX and 371).

Our North American elm-feeder, as recorded by Hoover, has quite different habits for it hibernates in an early stage, feeds up through the spring, forming its final case in June; the moth emerges in July. The case, too, is different from that of *limosipennella*, being more or less upright on the leaf (mouth-opening 4). I have seen no material from the Brooklyn area but we have a long series in our collection bred from elm-cases secured in southern Ontario which fit Hoover's description excellently. Judging by the genitalia of these, the species, as far as I can tell is not identical with the European species. Barasch gives a rather sketchy and superficial description of the male genitalia which, I confess, I cannot tie down definitely. Pierce (1935, Genit. Brit. Tin., Pl. XLI) gives figures of both male and female genitalia, neither of which match my Ontario

PLATE I.



Female Genitalia of 1. *Coleophora laticornella* Clem.; 2. *C. lentella* Heinr.; 3. *C. ostryae* Clem.; 4. *C. alnivorella* n. sp.; 5. *C. ulmifoliella* n. sp.; 6. *C. betulivora* n. sp.

slides; this is especially the case with the female organ in which the bursa is depicted by Pierce as possessing a well-defined signum with curved spine; in our Canadian species the signum is obsolescent, being reduced to a minute hook on a small chitinous base. Our common Canadian case-bearer on white birch (*Betula papyrifera*) has also been determined for us by Washington authorities as *limosipennella* but shows distinct genitalic characters from the elm-feeder although very similar in larval habits and type of case; it is very closely associated with *umbratica* Brn. and *comptoniella* McD., the genitalia of all three being practically identical.

Milvipennis Zell. and *badiipennella* H. S. (nec Dup.) are two other European names credited to this group but apparently much confused and misidentified by the various authors who list as larval food-plants such widely separated trees as maple, elm, birch and even sloe and ash. Barasch makes *badiipennella* a simple food-variety of *milvipennis* on the strength of similarity of genitalia but fails to give any information on the source of his material or the correct food-plants of these two species although he may probably be following Heinemann in considering birch and elm, respectively, as the trees on which the cases may be found; Pierce figures the genitalia of *badiipennella* but his figures do not seem to agree well with any of my slides, coming closest in the female sex to our common species on birch which I am discussing later in this paper. Turner (1907, Ent. Rec., 39) gives the best description of larval habits known to me.

Lacking authoritative studies of the European species I can see at present no other course open than to consider our North American forms as distinct from the European ones; this involves the creation of several new names but it is to be hoped that the genitalic figures and the data on larval habits given will be ample to tie down these new names satisfactorily and eventually to co-relate them with their European allies, which, to my mind, are badly in need of a revision.

Coleophora alnivorella n. sp.

Haploptilia alniella McDunnough (nec Heinrich) 1933, Can. Ent. LXV, 163, Pl. X, fig. 8 (case).

Scarcely to be distinguished in coloration and maculation from *comptoniella*, being of the same light brown color with diffuse white streak along the costa; the antennae are somewhat less sharply ringed with brown, especially toward the apex. The essential difference is found in the genitalia.

Male Genitalia. (fig. 6). (Specimens examined: 4 ♂, S. Milford, N. S., Smith's Cove, N. S., Bobcaygeon, Ont., Biscotasing, Ont.). General type of the organ similar to that of other members of the group. Sacculus hook rather broader than usual, with blunt, slightly recurved apex; it extends along the caudal margin of the clasper but does not attain its dorsal margin. From the ventral surface of this hook, slightly distad of its base, a small, but quite prominent tooth juts out. Aedeagus rather short and slender, flat dorsally and deflected in its apical portion, narrowing somewhat from base to apex. Vesica with the usual obscure armature.

Female Genitalia. (Pl. I, fig. 4). (Specimen examined: 1 ♀, Smith's Cove, N. S.) Genital plate slightly broader than high, rather flat and rectangular with the latero-caudal edges little rounded. Lobes narrowly separated at middle of caudal margin of plate, then strongly incurved, forming a broad, circular space above the ostium. Ostium near cephalic margin of plate, moderately broad, lunate, weakly chitinized. Initial portion of ductus bursae as broad as ostium, membranous and finely spiculate; later the tube narrows somewhat and continues for a short distance until it enters the long neck of the narrow, very elongate, membranous bursa. Signum a moderate spine, little curved and resting on a small base.

Larval Case. The only case before me is the one figured in my 1933 paper. In general it is very similar to those of *alnifoliella* and *betulivora* and rests at about the same angle on the foliage.

Holotype—♂, South Milford, N. S. June 26, 1934 (J. McDunnough) No. 5628 in Canadian National Collection.

Allotype—♀, Smith's Cove, N. S. July 19, 1945 (J. McDunnough).

Paratypes—1 ♂, S. Milford, N. S. June 24, 1934 (J. McDunnough); 1 ♂, Bobcaygeon, Ont., July 8, 1931, (J. McDunnough) (bred from *Alnus*); 1 ♂, Biscotasing, Ont., July 4, 1931 (K. Schedl).

The female which I have made the allotype was taken around an alder bush on the same spot where a very worn male—undoubtedly this species by genitalia—was captured; this association seems fairly safe. The female genitalia run quite close to what Pierce figures as *limosipennella* (1935, Gen. Brit. Tin., Pl. XLI) but his male figure is difficult to co-relate; in any case there is no assurance as to the correctness of Pierce's identification.

Food-plant—*Alnus*.

Coleophora ulmifollicella n. sp.

Coleophora limosipennella Hoover, (nec. Dup.) 1904, Ent. News, XV, 54; Felt, 1905, Mem. (8) I, N. Y. Mus., 167, Pl. 34; Heinrich, in Forbes, 1924, Mem. 68, Conn. Agr. Exp. Stn. 212.

Very similar to *laticornella* Clem., the brown color of the forewings being slightly paler and the fringes, especially along the inner margin, less tinged with smoky and with basal dark scaling less obvious. Palpi, head, thorax and basal joint of antennae light cream-ochreous with a faint brownish tinge; second joint of palpi shaded with smoky outwardly and with a minute terminal hair-tuft; antennae definitely ringed with brown to apex but this color not as deep as in *laticornella*. Primaries uniform brown, somewhat deeper in shade along inner margin and at base; a narrow, well-defined white streak along costa from base to costo-apical fringes, the extreme costal edge brown. Costal fringes concolorous, those along inner margin tinged with light smoky. Secondaries and fringes light smoky. Legs deep brown. Expanse 10-12 mm.

Male Genitalia. (fig. 7). (Specimens examined, 4 ♂, Chatham, Morpeth, Windsor, Lincoln Co., southern Ontario, bred from elm.). In general appearance quite similar to those of *laticornella*. Clasper and valvula longer and narrower. Saccus with caudal margin more oblique and scarcely differentiated from ventral margin; terminal hook rather short, feebly recurved, and only extending about halfway across clasper; closely approximate to its apex a small secondary tooth juts upward from its dorsal margin (very occasionally somewhat obscure). Aedeagus short and chunky with broad, flat dorsum, downcurved and feebly striate in apical section, unarmed; sides parallel from base to the usual outwardly oblique apex; vesica with the usual traces of a thin, appressed cluster of cornuti in central area. Gnathos obliquely oval.

Female Genitalia. (Pl. I, fig. 5). (Specimens examined: 5 ♀, Chatham, Morpeth, Windsor, Sarnia, Lincoln Co., southern Ontario, bred from elm.) Genital plate somewhat broader than high, strongly convex with the lobes well separated in median area; the lateral edges of the plates are rounded caudally, and the opposing edges of the lobes are also rounded on the caudal margin, sloping then obliquely outwardly to the ostium. Ostium situated in central area of plate, a broad, transverse opening, leading into the short, equally broad, oval, initial section of the ductus bursae which is membranous and feebly spiculate; narrowing sharply the ductus forms a short tube which gradually expands into the long neck of the oval bursa. Armature of bursa consists merely of a short blunt spine, representing a much reduced signum.

Larval Case. A somewhat flattened cylinder, dull smoky-brown, with mouth deflected about 45°, flatly compressed and slightly broadened apically

with the sharp, posterior edge generally evenly curved, although examples occur at times with straight edge. Following the texture of the leaf the case is rather rough-haired and the dorsal margin may be either smooth or variably dentate, according to whether the case has been constructed from the central or outer portions of the leaf. Length 9-10 mm.

Food Plants. White Elm, Slippery Elm, Rock Elm, Swamp Elm.

Holotype—♂, Chatham, Ont., July 8, 1942 (bred from case on elm); No. 5625 in the Canadian National Collection, Ottawa.

Allotype—♀, same data, July 21.

Paratypes—6 ♂, 5 ♀, Chatham, Ont. (dates from July 14-29, on elm); 13 ♂, 13 ♀, Lincoln Co., Ont., July 13-21 (on elm); 3 ♂, 3 ♀, Morpeth, Ont., August 2, 3, (on swamp elm); 4 ♂, 1 ♀, Sarnia, Ont., August 2 (on elm).

The general life-history of the species has already been discussed. It might be noted, however, that evidently other species of elm-feeders occur in America; in September, 1944, some smaller, flatter cases were secured on white elm in the western outskirts of Ottawa; the larvae were certainly alive at the time but hibernated and unfortunately only produced parasites in the spring. In the fall of 1945 further search resulted in the collecting of a number of similar cases on the white elms in the eastern suburbs of Ottawa; late in the month the larvae settled down for hibernation, attaching the cases to twigs or to the edges of the breeding-tin and the adults will presumably emerge in the spring of 1946; such habits are suspiciously like those of the European elm-feeder. Dr. Braun further states in correspondence that a small case, about the size of that of *ostryae*, is found rarely on elms in the Cincinnati region, she has bred three specimens (1 ♂, 2 ♀); I have examined the male (now returned) and it certainly seemed distinct; it is quite possible that it is identical with our unknown Ottawa species.

The following group contains several apparently good species in which, however, no definite genitalic distinctions can be found. The larvae appear, however, to be restricted to individual food-plants; in some instances the cases may be distinguished by coloration or size, or both; in others the adults, while showing little in wing-coloration which can be used as a means of separation, vary so markedly and constantly in size as to render this character an important one.

Coleophora umbratica Brn.

Coleophora umbratica Braun, 1914, Jour. Cin. Soc. Nat. Hist., XXI, 160; Heinrich, in Forbes, 1924, Mem. 68, Corn. Agri. Exp. Stn. 211.

This species is only known to me through a single topotypical male kindly furnished by Dr. Braun. It is the smallest species in the group, my specimen measuring only 8 mm. wing expanse. The color of the primaries is a light ochreous brown, deepening slightly toward apex and the white costal edge is not sharply defined but blends into the brown ground color, especially toward base of wing. This type of coloration characterizes the whole group. The male genitalia are very small and from the single available slide I cannot differentiate them, except in size, from those of our common feeder on white birch, to be discussed later. The larval case is short (5-6 mm.) and very dark—almost black—in color, a distinctive feature, if constant. The life history also differs markedly in that the larva hibernates in its final case practically full grown, feeding (according to the original description) only a short time in spring, then pupating and emerging as an adult in June and July. The species has been wrongly associated by Heinrich with the *ostryae* group; according to genitalia its present position seems more correct.

***Coleophora comptoniella* McD.**

Haploptilia comptoniella McDunnough, 1926, Can. Ent., LVIII, 218: *id.*, 1933, *op. cit.*, LXV, 163, Pl. X, fig. 17 (case).

Considerably larger (9-11 mm.) than the preceding species but very similar in coloration of forewing. In the type series the brown coloration is very light golden-brown but in other specimens from Annapolis, N. S., bred from sweet-fern cases, this color is decidedly deeper and the whitish area at base of wing not quite so extended. The antennae are annulate with brown for their entire length. I have examined 5 ♂, 3 ♀ specimens and can detect no essential differences in either male or female genitalia from those of the following species which is treated in full detail. A fairly typical photograph of the bright brown case is given in my 1933 paper; in most instances the notch on the dorsal edge below apex is present but there is considerable variation in the width of the case above the mouth opening, some cases being quite narrow and cylindrical in this section whilst others are broadly flattened; the posterior edge is mostly straight but at times may be slightly rounded. The full-sized cases (8 mm.) occur in late June and the adult emerges a couple of weeks later.

In 1945 an effort was made, during my field work in the Maritime provinces, to secure further material from Annapolis, N. S. After a good deal of searching on sweet-fern about ten cases were collected in the second week of July. Unfortunately nothing but parasites emerged in late July; however, in two of the cases the larvae remained alive during the summer, changing their position every once in a while but apparently without feeding; it would appear as if, in individual instances, the larvae departed from the normal habit of quick pupation and emergence the same season, to carry over in a full-grown condition to the following spring but nothing definite can be stated at the present time in this connection. The species is widespread but never very common and quite hard to find. There are specimens in our collection from Sparrow Lake (types), and the Ottawa region, Ont., as well as from Petite Riviere and Annapolis in Nova Scotia.

***Coleophora betulivora* n. sp.**

Haploptilia limosipennella (nec. Dup.) 1933 Can. Ent., LXV, 162, Pl. X, figs. 6, 7.

The largest species in the group, especially in the female sex, averaging 11-13 mm. in wing expanse.

Palpi, head, thorax and basal joint of antennae light creamy with a very faint brownish tinge, especially noticeable on the outer side of the second palpal joint and the underside of the weak tuft on the basal joint of the antennae. Balance of antennae alternately ringed with brown and white to tip. Primaries a light golden brown, the color deepening slightly toward tip of wing; costa rather broadly white basad of apical fringes, this pale area not sharply defined inwardly and tending to broaden at the base of wing; costal fringes concolorous, outer and dorsal fringes a very pale ochreous without smoky tinges. Hind wings and fringes light smoky. Legs pale brownish.

Male Genitalia. (fig. 8). (Specimens examined: 2 ♂, Ottawa region, 2 ♂, Bobcaygeon, Ont., bred from birch; 3 ♂, Bobcaygeon, Ont., bred from *Myrica gale*; 3 ♂, Parrsboro, N. S., bred from birch and alder, spring form). Differ chiefly from those of *ulmifoliella* in the position of the small inner tooth on the apical projection of the sacculus, this being considerably further basad of its tip than in *ulmifoliella*. The clasper is somewhat broader and chunkier; the unarmed aedeagus is longer, more deflected apically and considerably thinner, the lateral edges converging somewhat toward the apex and thus forming a blunt tip. The usual weak armature of the vesica is present.

Female Genitalia. (Pl. I, fig. 6). (Specimens examined: 4 ♀, Ottawa region, 2 ♀, Bobcaygeon, Ont., bred from birch; 3 ♀, Bobcaygeon, Ont., bred from *Myrica gale*; 4 ♀, Parrsboro, N. S., bred from birch and alder, spring form.) Genital plate flatter and broader than in *ulmifoliella* with less rounded caudal margins; lobes separated in median area, the opposing edges running parallel

for some distance before separating further; *ostium* much closer to *cephalic margin* than in *ulmifoliella* and more definitely lunate. Ductus bursae short and much as in *ulmifoliella* but *signum* of bursa large and with sharp spine arising from a long curved base, the whole anchor-shaped.

Larval Case. In general very similar to that of *ulmifoliella*. Deep brown, flatly cylindrical, dorsal edge frequently and variably serrate (when case is formed from outer edge of leaf), posteriorly compressed with the sharp terminal edge straight or very slightly curved; mouth deflected to about 45° but rather variable in this respect. Length 9-11 mm.

Holotype—♂, Ottawa East, June 28, 1944 (J. McDunnough) (Bred from *Betula papyrifera*); No. 5626 in the Canadian National Collection, Ottawa.

Allotype—♀, same data, July 10.

Paratypes—4 ♂, 2 ♀, same data, July 1-4, 7 ♂, 4 ♀, Bobcaygeon, Ont., July 13-22, 1932 (J. McDunnough); 2 ♀, same data, July 2, 1931; all bred from *B. papyrifera*.

As already noted this is the common species on white birch in eastern Ontario; occasional cases have also been found on yellow birch of two rather dissimilar types; in one instance the cases were much as those on white birch with very strong dorsal serrations; in the other (of which only three were obtained) the case was smooth, blackish and deflected much as in *lentella*. The odd females bred from both types of cases seemed to agree both with each other and with the white birch feeders in genitalic characters but our material at present is too scanty to decide the point definitely.

The larvae in the Ottawa region hibernate in a small, curved, blackish case—probably the second one formed—commence feeding as soon as the leaves unfold in spring, cutting the final and very much larger case from either the edge or the central portion of the leaf in late May or early June, according to the season; when full fed they crawl away from the leaves and generally attach the cases to the twigs or trunk of the tree for pupation, the moth emerging in late June or early July.

In both 1943 and 1944 I secured numerous cases, practically similar to those of our Ontario birch-feeder, on low second-growth birch-bushes of *B. populifolia* and *B. papyrifera* and also on *Alnus* at Parrsboro, N.S. These cases first appeared in their final stage about the middle of July, the larvae feeding spasmodically until late in August when they attached the cases to twigs or bits of bark and proceeded to go into hibernation. In spring they either remained quiescent or crawled about for a short time before reattachment. No further feeding took place, the larvae evidently pupating immediately; the moths emerged in the laboratory in April but in nature would probably not appear until considerably later in the season. Such a life-cycle is quite at variance with that of our local form and is strongly reminiscent of the British species on birch recorded as *limosipennella* by Waters (1927, Ent., Mon. Mag., 182); it seems to represent however, the normal cycle in Nova Scotia as far as is known at the present time. As I can find no differences either in wing-coloration or genitalia between this form and typical Ontario *betulivora* I believe there is nothing to be gained in holding the two forms under different names; such variability in life-cycles has been already noted in the *Juncus*-feeder, *glaucicolella* Wood, and there are hints of the same thing occurring in the close ally, *comptoniella* McD.

In my 1933 paper I mentioned the occurrence at Bobcaygeon of similar cases on *Myrica gale* which produced adults somewhat later than the birch-feeders but in all respects (including genitalia) similar. After a further examination of our series I do not feel justified in creating a new name for these but would include them under *betulivora* with *Myrica* listed as an alternate food-plant; a single case was also collected at Smith's Cove, N.S., on bayberry (*Myrica carolinensis*) in late August, 1945, which is now hibernating, being similar in this respect to the birch and alder feeders mentioned above.

Food Plants. *Betula*, *Alnus*, *Myrica*.

THREE NEW MITES FROM NOVA SCOTIAN APPLE TREES

BY HERBERT H. J. NESBITT,
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Family Stigmaeidae Oudms. 1931

***Mediolata novae-scotiae* n. sp.**
(figs. 1-6 incl.)

This mite is commonly found on the under side of apple leaves near the midrib, although it has been taken on some of the associated orchard flora. Very little is known about its life-history except that it has been seen overwintering beneath oystershell scales and bits of bark. The workers in Annapolis Royal state that they have seen it feeding on the eggs of *Bryobia praetiosa* Koch; and, I have seen it eating the eggs of *Sieulus pomi* (Parrot). There is also circumstantial evidence to the effect that this mite will feed on blister mites. Normally it moves rather slowly but when disturbed is capable of rather rapid movement. Usually it is lemon-yellow in colour, with a chalky-white or creamy-yellow stripe down the back, though all stages of orange to red have been found. A critical examination of specimens from all three colour groups has failed to show any morphological differences. Since all three can be found, if not on the same tree, at least in the same orchard, the conclusion is patent that the differences in colour are either caused by different foods (i. e., a diet of *Bryobia praetiosa* eggs could easily produce a red colouration) or are the result of genetic or physiological differences.

Description: Male. Measured from the posterior margin of the opisthosoma the average length of the mature male is .23 mm. to the anterior margin of the propodosoma; .30 mm. to the tips of the chelicerae; and .37 mm. to the tips of the pedipalpi. The body is ovoid in shape with the point directed posteriorly and covered dorsally by nine mildly sclerotized plates (*vide* figure 1) which are separated by areas of striated flexible chitin. As may be seen from the figure, the propodosoma is covered by a single plate which bears the eyes and three pairs of setae. All the dorsal setae of the body are heavily pectinated. The hysterosoma has one large central plate which carries three pairs of setae; three smaller plates surrounding this central one each with one seta; and a transverse posterior plate which bears two pairs of setae, the centre pair of which are only about one-half as long as the outer. On some specimens this last mentioned plate is divided into a central plate and two laterals (*vide* dotted lines). The anus is located on the dorsal surface at the extreme posterior end. A minute seta is located on each anal flap.

The ventral surface is covered with soft chitin which is striated in the manner of finger-prints. Coxae I and II are closely appressed, directed forward, and separated from the posteriorly directed coxae III and IV by a space almost equal to their own width. The setae of the ventral surface are unpectinated, fine, and located as follows: two on coxae I and III, one on coxae II and IV, two on the sternal space between coxae II, two between and just anterad of coxae III, two between coxae IV forming a transverse line with those on coxae IV, and a single pair of setae about one-half way down the genital area.

The chelicerae are composed of two parts — a large free basal portion which terminates anteriorly in a blunt point and a long stylet which arises from near the front of the ventral surface of this and extends forward as far as the middle of the femur of the palp. The pedipalp is shown in toto in figure 1 and in part in figure 5. When extended it reaches anteriorly as far as the middle of tarsus I. It is terminated by a simple unmodified tibial claw from whose base arises the fleshy tarsus ("thumb") which bears three setae near its base and two simple setae in addition to a modified seta on its tip.

The four pairs of legs are all approximately equal in length, slightly longer than half of the length of the body proper and directed two forward, and two

*Contribution No. 2418, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

backward. The tarsus of the first leg is shown in figure 3. It bears the following structures: distally, two claws and an onychium on a modified caruncle which is supported by two chitinous bars, two large dorsal setae which extend beyond the tip of the onychium, and four lesser terminal setae — two dorsal and two ventral; medially, one long setae on the dorsal face, two rather short ones placed respectively on the lateral and ventral faces, and one long thin modified seta on the dorsal surface; and proximally one larger modified seta which like the preceding structure has probably a sensory function. The tarsi of legs II, III, and IV are fundamentally similar to tarsus I except that the large dorsal terminal setae arise from progressively more proximal positions on subsequent tarsi and the sensory setae show some modifications, i.e., on tarsus II there are two large sensory setae, as long and as plump as the proximal seta on tarsus II whilst on tarsi III and IV only the distal seta has been retained and then much reduced in size. The onychium of all tarsi is composed of a central rib and four pairs of lateral needles each of which bears a little pad on its free end.

A side view of the penis is shown in figure 6. When seen in situ through the ventral surface, it appears to be a long chitinous bar which extends from just behind coxae IV to an opening at the extreme end of the body immediately ventrad of the anus.

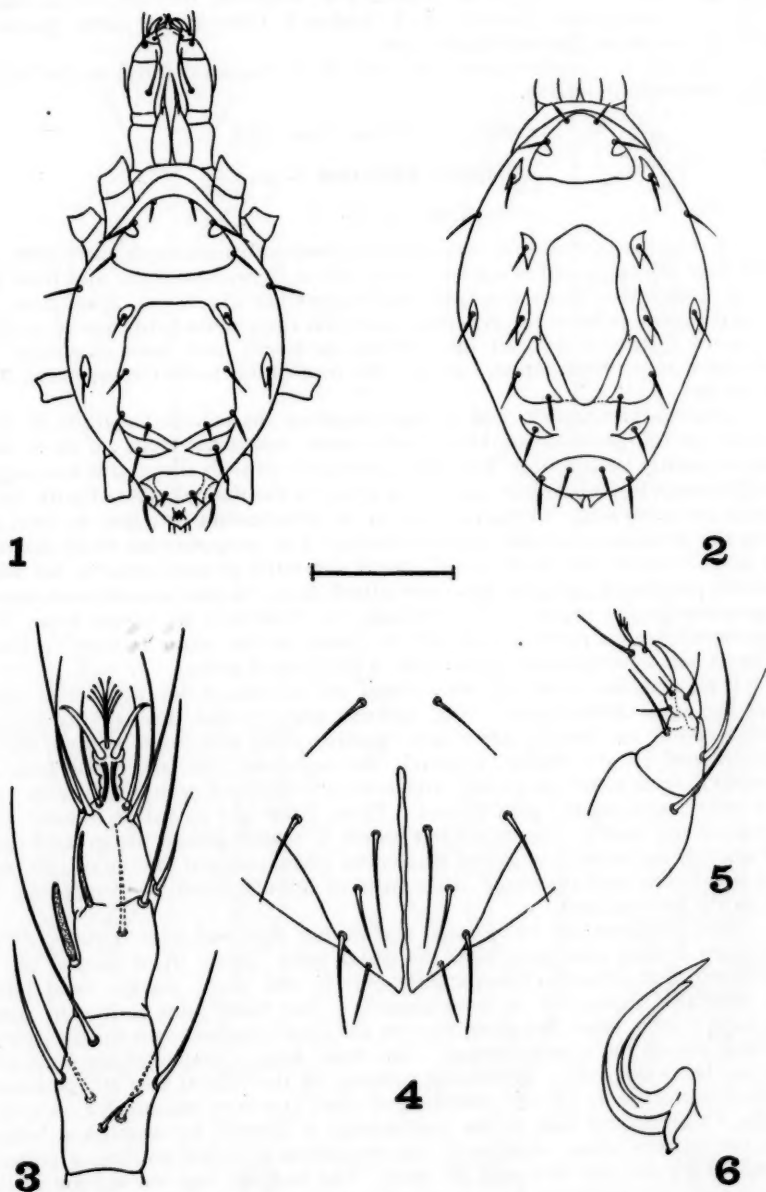
Female. Measured from the posterior margin of the opisthosoma the average length of the mature female is .32 mm. to the anterior margin of the propodosoma; .39 mm. to the tips of the chelicerae and .44 mm. to the tips of the pedipalps. In general, the body of the female is more oval than that of the male which results from the broadening of the posterior end. It is covered dorsally by fifteen indistinct and irregularly striated plates (*vide* figure 2) which bear the setae. In several specimens the large central hysterosomatic plate is fused with the platelets at its postero-lateral corners (*vide* broken lines on figure 2). The ventral setae of the central part of the body are arranged as in the male. The genital area, however, bears six pairs of setae (*vide* figure 4). The chelicerae, pedipalps, and legs of the female are equal in length to, and bear the same setae as are found on the corresponding members in the male except that the sensory setae of the tarsi show some modifications. The more proximal of these setae is missing on tarsi I and II and the distal setae has assumed the shape and size of the proximal seta of the male. No sensory setae are to be found on tarsus IV although they are present on tarsus III.

Notes. The specific name *novae-scotiae* has been given to this mite in honour of the province where it was found. It is most closely related to *Mediolata mali* (Ewing) and *M. terminalis* (Quale). It differs from the latter in several respects, viz., in *terminalis* the dorsal body setae are longer, more sparsely and more distinctly pectinated; the sensory setae on tarsi I and II are longer, thinner and more curved; the tarsi are shorter; and the tarsus of the palp is shorter and plumper. It differs from the former in the nature and arrangement of the dorsal body plates. A word of amplification is necessary for the latter statement. In both sexes of *mali*, the dorsal plates are sculptured in a low and barely perceptible hexagonal pattern. In *novae-scotiae*, as in *terminalis*, no marking of any kind other than irregular striations in the female may be seen. Furthermore, in the females of *mali* the dorsal plates are similar in shape and disposition to those of the males (*vide* figure 1) of *novae-scotiae*. In the females of the latter, however, the hysterosomatic plate is divided into four smaller platelets and a central shield. In addition to this difference, the median setae of the tibia of leg I are shorter than in *mali*.

Type Habitat. Under surface of apple leaves, Berwick, N. S.

Holotype. ♂, Berwick, N. S., August 8, 1945 (H. H. J. Nesbitt), No. 5686 in the Canadian National Collection.

PLATE II.



NEW MITES

Allotype. ♀, same data.

Paratypes. 34 ♂♂, 9 ♀♀, same data; 8 ♂♂, 4 ♀♀, apple leaves, and stems, Berwick, N. S., August 8, 1925; 2 ♀♀, dogbane, Berwick, N. S., August 8, 1945; 1 ♀, soft maple, Berwick, N. S., August 8, 1945. All the above specimens are in the Canadian National Collection.

7 ♂♂, 1 ♀, apple leaves, Berwick, N. S., August 8, 1945; in the United States National Collection.

Family Cunaxidae Thor 1902

***Eupalus biscutum* n. sp.**

(fig. 7, 9, 10, 11)

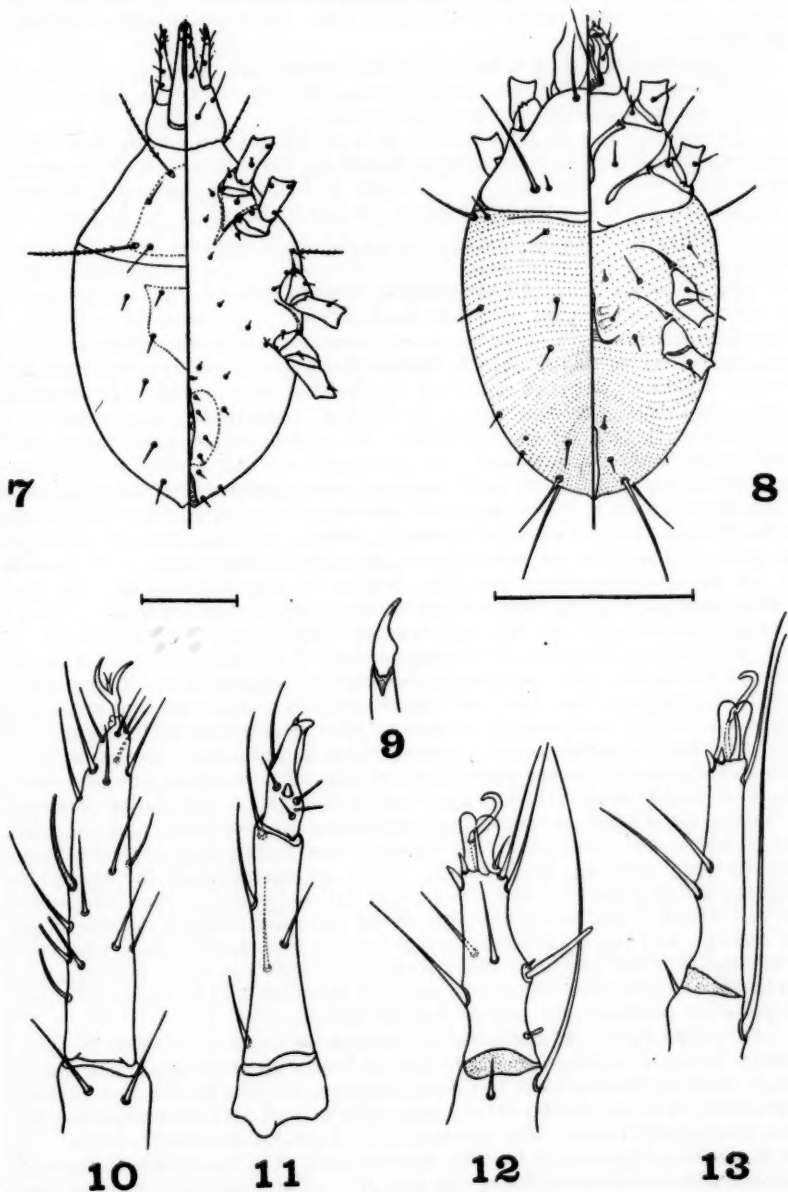
In the summer of 1945 several small, dark-amber-coloured mites were collected from the calyx end of apples, under bits of lichen and bark, and from the base of apple leaves. Little is known concerning their life-history, apart from the fact that they appear to be predacious and that their movements are very rapid but erratic. Despite the fact that several specimens have been examined, no males have as yet been found. Hence, the description herewith presented is of the female.

Description: Female. The average length of the mature female is .48 mm. inclusive of the gnathosoma. Other individuals measuring from .44 to .5 mm. have frequently been found. The body is roughly oval in shape and completely covered except for two mildly sclerotized areas on the dorsum (*vide* figure 1) by a finely wrinkled skin. No distinct furrow or demarcation line may be seen between the propodosoma and the hysterosoma. The propodosoma bears dorsally four pairs of setae: two of these, the rostral and outer propodosomatic, are long, distinctly pectinated and arise from specialized setae pits which are reminiscent of the pseudostigmatic organs of the Oribatei, the other two are simple setae. The hysterosoma has six pairs of setae on the dorsal surface (*vide* figure 7). These are about half as long as the simple setae of the propodosoma.

The striations cover all the ventral surface except for little clear areas about the coxal articulations. The epimera may be seen through the integument; I and II are heavily sclerotized, readily visible and fused at their mesial ends; III and IV are smaller, relatively inconspicuous and free. The setae of the ventral surface are very small and arranged in three groups about the anterior coxae, and on the genital area. These latter are placed as follows: two anterad of the heavily sclerotized bar which is placed before the genital cleft, four towards the mesial margin of the genital cover, one just laterad of this, and three beside the anal opening. Two pairs of minute ovoid structures may be seen in the genital cleft.

The chelicerae are two-jointed and do not bear any setae dorsally. The basal joint is long and spout-like; the distal joint (figure 9) is shaped like a duck's head and articulates, apparently only in one plane, on the basal joint. The pedipalp (figure 11) is three-jointed. The basal joint is free of setae. The second joint bears five setae, two on the dorsal surface, two on the lateral face, and one on the ventral surface. The distal joint is shaped in the form of a claw and bears three setae and a little tubercle on the ventral face and two setae on the dorsal surface. At the extreme end there is a very minute seta on a tiny papilla. The ventral face of the gnathosoma is covered by membrane, which bears two pairs of setae. Anteriorly this membrane is drawn out into a pointed labium which also has two pairs of setae. The anterior legs are as long as the body is wide, the posterior are somewhat longer and slightly but not noticeably heavier. Tarsus I is shown in figure 10. It is terminated by a bifurcated claw and a rudimentary onychium, and has twenty-one setae. Some of these on the lateral face are truncated and one in particular appears to be a sensory seta.

PLATE III.



NEW MITES

Note. The two shields or shield-like areas on the dorsal surface of the body have suggested the specific name "*biscutum*" for this mite. It is very closely related to Ewing's *Eupalus pectinatus* but differs from it in having only a small tubercle on the third palpal joint rather than the large structures found on that species.

Type Habitat. Calyx end of apples, Berwick, N. S.

Holotype. ♀, Berwick, Nova Scotia, October 11, 1944. (F. T. Lord), No. 5687 in the Canadian National Collection.

Paratypes. 5 ♀♀, same data; 4 ♀♀ on base of leaf and apple twigs, different orchard, Berwick, N. S., August 9 and 10, 1945; 2 ♀♀ under oystershell scale, same orchard, Berwick, N. S., August 9, 1945; 1 ♀ on apple, Aldershot, N. S., May 30, 1945; 1 ♀ on apple leaves, Annapolis Royal, N. S., August 6, 1945.

Family Czenspinskiidae Oudms. 1927

Czenspinskia lordi n. sp.

(figs. 8, 12, 13)

This mite has been taken on several occasions and at all seasons of the year from apple trees in the Annapolis Valley, Nova Scotia. Usually it is found in colonies or clusters near the midrib of the leaf but occasionally individuals may be seen wandering over the surface of the leaf. Apparently it overwinters beneath lichens and old oystershell scales. As no males have been found in the hundreds of specimens examined, in many cases a whole colony was mounted, the conclusion is fairly patent that this mite must reproduce parthenogenetically. It is pearly-white or yellowish in colour and frequently bears three distinct spots on the dorsum caused by the two laterally placed "oil" or excretory glands and the central bolus of the gut which shows through the integument. An examination of the gut contents shows that it feeds on vegetable matter. In many mounts, apple-scab spores were readily visible in the cleared specimen. Since no males have been found, the description given below is based on the female.

Description: Female. The average length of the mature female is .25 mm. It shows its affinity with the family Acaridae (Tyroglyphidae) in the general shape and structure of the body and the disposition of the body and tarsal setae. Unlike an Acarid, however, it is covered with a finely wrinkled skin whose folds* are most noticeable in the humeral region and about the terminally placed anus. On the propodosoma (*vide* figure 8) Grandjean's organ has assumed the form of a nuchal bristle,** the pseudostigmatic organ is very finely pectinated, the inner propodosomatic setae are placed close to the outer, and the rostral setae overhang the chelicerae. The cervical setae are missing. On the hysterosoma the usual setae are to be found. With the exception of the ventral submarginal, which is approximately as long as half the width of the body, and the marginal which is slightly shorter, the dorsal setae are reduced to little bristles. The anterior and posterior interepimeral bristles are relatively long whereas the paragenital are only of intermediate length. As only two little bristles may be seen beside the anus, it is difficult to say what these are and whether the anterior and posterior postanal setae are present or missing.

The chelicerae and pedipalps are similar to those of any Acarid, such as *A. siro*. Tarsus I is shown in figure 12. It bears the usual setae with this difference, that the parasubbasal, the dorsal median, and the mesian terminal setae are missing. The macrosense seta is long, rod-like and placed at a decided angle to the shaft of the tarsus. The caruncle is large and almost pedunculate. The claw is small and supported by long slender rami. On legs I and II the dorsal tibial and outer member of the paired genual setae are large and unusually long.

*The wrinkles on the body are schematically shown in figure 8. In this figure they are placed much farther apart than on the specimen because, in reality the folds are so close together, that an accurate delineation would blur the drawing.

**For an explanation of these terms, see Nesbitt (1).

Tarsus IV is shown in figure 13. It too, lacks such terminal setae as the second dorsal and lateral terminal. The eggs of this species are large, oval in shape, and are laid singly. In cleared specimens there is seldom more than one egg to be seen at a single time.

Note. This mite is closely related to *Czenspinskiia heterocomus* (Michael) but differs from it, however, in the following ways. It is smaller, being only .25 mm., whereas *heterocomus* measures approximately .3 mm. in length; the legs and tarsi, in particular, are relatively shorter as are the dorsal tibial spines on tarsi I and II and the lateral spine on tarsus IV. In *heterocomus* the dorsal tibial spine is 1.5 times as long as the tarsus whereas in the species under consideration it is 1.3 times as long.

This mite has been placed in the genus *Czenspinskiia* because it agrees very closely with a specimen of *C. heterocomus* which is in the Oudemans Collection in the Rijksmuseum voor Natuurlijke Historie, Leiden. The genus *Czenspinskiia* is a new genus which Oudemans established in 1927 to accommodate *Tyroglyphus heterocomus* Michael. The Dutch author was of the opinion, and I believe rightly so, that Michael's specimen was not a true Acarid (Tyroglyphid) and as such, should be placed in a genus by itself. In the same year he created a new family for this genus.

The reader's attention should be drawn to certain statements which Oudemans (2) made about this genus and which I think should be changed. In the 1927 key, under G. 3 he states that the female and male genital aperture in the family of Czenspinskiidae is behind coxae IV. In the above-mentioned specimen which was found on *He'iotropium corymbosum* Wageningen, 18-12-1921, the female genital aperture is between coxae III and IV. The slide does not contain a male. In fact in the above-quoted paper on page 247, Oudemans states that the male is unknown to him and hence his statement about the male is open to some doubt. The key should be changed and the classification based on some character other than the position of the genital opening but as I have been unable to see any specimens from the neighbouring families Ensigniellidae Vitzthum 1924, and Winterschmidtidae Oudms. 1924, this cannot be done at the present time. The families Winterschmidtidae and Czenspinskiidae, however, which are described under G. 2 and 3 can easily be separated on the nature of the tarsi. In the former, which is based on a single genus of one species, viz., *Winterschmidtia hamadryas* (Vitz.), the tarsi are short and bear terminal spines which are reminiscent of those found in the genus *Aleuroglyphus* whereas in the family Czenspinskiidae they are long, slender, and provided with minute spines.

The specific name *lordi* has been given to this mite in honour of Mr. F. T. Lord who first discovered it on apple trees and who has done much of the subsequent collecting.

Type Habitat. Under surface of apple twigs, Deep Brook, N. S.

Holotype. ♀, Deep Brook, Nova Scotia, July 22, 1944. (F. T. Lord), No. 5688 in the Canadian National Collection, Ottawa.

Paratypes. 9 ♀♀, 1 immature ♀, same data; 2 ♀♀, 2 immature ♀♀, apple twigs, Deep Brook, N. S., summer 1944; 18 ♀♀, apple twigs, Deep Brook, N. S., March 22, 1944; ♀♀, apple leaves, Deep Brook, N. S., August 7, 1944; 4 ♀♀, 2 immature ♀♀, apple leaves, Berwick, N. S., August 8, 1944; 16 ♀♀, apple leaves, Annapolis Royal, N. S., August 3, 1945; 7 ♀♀, apple twigs and base of leaves, Cornwallis, N. S., August 3, 1945; 9 ♀♀, under oystershell scale, Berwick, N. S., August 9, 1945. All the above specimens are in the Canadian National Collection.

13 ♀♀, 2 immature ♀♀, apple leaves, Berwick, N. S., June 14, 1945, in the United States National Museum.

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1. Nesbitt, H. H. J. A revision of the family Acaridae (Tyroglyphidae), order Acari, based on comparative morphological studies. Part I. Historical, Morphological, and General Taxonomic Studies. Can. Jour. of Research, D. 23 (6): 139-188, ill., 1945.
2. Oudemans, A. C., Acarologische Aanteekeningen LXXXVII. Entom. Ber. 7 (157): 242-248, 1927.

EXPLANATION OF PLATES II. AND III.

- Figure 1. *Mediolata novae-scotiae* n. sp., male, dorsal view.
 Figure 2. *Mediolata novae-scotiae* n. sp., female, dorsal view.
 Figure 3. *Mediolata novae-scotiae* n. sp., tarsus I.
 Figure 4. *Mediolata novae-scotiae* n. sp., ventral view of posterior part of female opisthosoma to show the setae.
 Figure 5. *Mediolata novae-scotiae* n. sp., terminal claw of pedipalp.
 Figure 6. *Mediolata novae-scotiae* n. sp., penis.
 The heavy black line between figures 1 and 2 pertains to these figures only and represents 0.1 mm.
 Figure 7. *Eupalus biscutum* n. sp., dorsal and ventral view of the female, (the left side represents the dorsal surface; the right the ventral).
 Figure 8. *Czenspinksia lordi* n. sp., dorsal and ventral view of the female, (the left side represents the dorsal surface; the right the ventral).
 Figure 9. *Eupalus biscutum* n. sp., terminal joint of the chelicera.
 Figure 10. *Eupalus biscutum* n. sp., tarsus I.
 Figure 11. *Eupalus biscutum* n. sp., pedipalp.
 Figure 12. *Czenspinksia lordi* n. sp., tarsus I.
 Figure 13. *Czenspinksia lordi* n. sp., tarsus IV.
 The heavy line beneath figures 7 and 8 pertains to these figures and represents 0.1 mm.

OCCURRENCE OF THE
 ELM LEAF BEETLE, *GALERUCELLA XANTHOMELAENA* (SCHR.),
 AT ST. CATHARINES, ONTARIO

In July 11, 1945, in the city of St. Catharines, Ontario, while looking for some elm trees reported by Dutch elm disease scouts as being severely leaf-eaten, I found two white elms (*Ulmus americana* L.) carrying large numbers of coleopterous larvae which were at once taken to be referable to the elm leaf beetle, *Galerucella xanthomelaena* (Schr.).

The infested elm trees were situated within 150 feet of each other in a residential area of what may be called the eastern suburbs of St. Catharines, and from these two trees, and a few seedling elms in an adjacent garden, a number of larval specimens of this insect were collected. Between the date of collecting and July 25, a half dozen or so larvae were reared to the adult stage, under somewhat adverse conditions in the Plant Inspection Office while the larger proportion of the larval specimens died before reaching maturity. Following the emergence of adults in the office, Mr. F. W. Gregory and his two Dutch elm disease scouts were requested, on July 30, to procure specimens of adult beetles. They returned with about two dozen specimens and the report that the beetles were prevalent on the elms in the immediate vicinity.

Adult specimens, both office-reared and field-collected, were submitted to Mr. W. J. Brown, Division of Entomology, who confirmed my identification and advised that this was the first authentic record for Canada, earlier reports having been based on mis-identifications of *Altica ulmi* Woods.

R. W. Sheppard,
 Plant Protection Division,
 Niagara Falls, Ontario.

OBITUARY

THEODORE HENRY FRISON, 1895-1945

Many hearts were saddened when news reached us of the death of Theodore Henry Frison at the age of 50 years; he died during the evening of December 9, 1945, after an illness of over a year. Ted, as he was affectionately known by his many friends and admirers, was born in Champaign, Illinois, on January 17, 1895. Not many young men had his good fortune when he decided to become an entomologist. Living near him was his friend the late Prof. J. W. Folsom, who taught entomology at the University of Illinois. Encouraged by Folsom, who recognized his early ability, he took his training at the University, receiving the M.Sc. degree in 1920, and the Ph.D. degree in 1923.

His university studies were interrupted in April, 1918, when he entered the U. S. army, becoming a second lieutenant in the infantry the following August. In December he resumed studies at the University. Following graduation in 1920, he was appointed Assistant State Entomologist of Wisconsin, which position he held for about one year. He was then appointed to a position in the U. S. Bureau of Entomology, his headquarters being Moorestown, N. J. During these early years his progress had attracted the attention of Prof. Stephen Forbes, then Head of the Department of Entomology, University of Illinois, State Entomologist and Chief of the State Laboratory of Natural History. This led to his appointment, in 1923, as systematic entomologist on the Natural History Survey staff. Seven years prior to this latter year, the State Laboratory of Natural History and the office of State Entomologist were merged, the two forming the State Natural History Survey, with Forbes as Chief. Upon the latter's death in 1930, Frison acted as Head of the Survey until July 1, 1931, when he was appointed Chief, which position he held until his death.

The writer knew Ted quite intimately over a period approaching twenty years. He was extremely likeable, had a very hearty laugh and was ever ready for some fun or adventure. During the many years I attended the annual meetings of the American Association of Economic Entomologists and the Entomological Society of America, we always got together for a session or two. At other times when he visited Ottawa or other places in Canada we usually saw a good deal of each other. Memories of happy hours together will remain with me always.

Under Dr. Frison's direction much research concerned with the conservation of the birds, mammals and fishes of Illinois was inception as a result of which notable progress was made. At the first Midwest Wildlife Conference held in 1935, he emphasized the necessity of further wildlife research in the State. This he was able to develop with the aid of an increased staff of young technicians. In this connection mention may be made of the field laboratories established at Havana and Charleston where special investigations have been undertaken.

With the completion of the new Natural Resources Building in November, 1940, at Dr. Frison's request, the writer was authorized to represent the Dominion Department of Agriculture at the dedication ceremonies. At this time too, the sixth annual Midwest Wildlife Conference was in progress at Urbana. During the period Dr. Frison was the recipient of many congratulatory expressions from those present. He was, indeed, a very happy man now that he had well equipped laboratories, staff, etc., for the carrying on of the work he directed and to the future of which he looked with so much delight. In his death, the State has lost a most valuable servant and natural science a devoted worker.

Of Dr. Frison's entomological work much could be written. He was known internationally as a result of his studies of bumblebees, stoneflies, aphids, and other groups. Many contributions were published, a list of which will doubtless appear elsewhere. Among his recent publications, "The Stoneflies, or Plecoptera,

of Illinois" (1937), and "Studies of North American Plecoptera" (1942,) are important.

With his broad knowledge of the natural sciences and conservation, his leadership was acknowledged by the following organizations upon the executives of which he served at one time or another: Illinois State Academy of Science, Ecological Society of America, Illinois Audubon Society, Illinois State Archaeological Society, American Association of Economic Entomologists, Central States Forest Experimental Station, and Entomological Society of America. From 1936 through 1939, he was Editor of the *Journal of Economic Entomology*. Other organizations of which he was a member are the following: American Association for the Advancement of Science, Society of Wildlife Specialists, Limnological Society of America, American Wildlife Institute, American Society of Naturalists, Wilderness Society, Illinois State Florists' Association, Conservation Council of Illinois, Illinois Horticultural Society, Illinois State Nurserymen's Association, Izaak Walton League, and Illinois Federation of Sportsmen's Club.

Ted Frison was very fond of outdoor sports — tennis, golf, fishing, and hunting. Everything he did he seemingly enjoyed. During the World Congress of Entomology held at Cornell University in 1928, K. M. King and the writer were challenged to a tennis match by Frison and the late W. P. Flint. Word got around that this was an international match between Canada and the United States, and much to our surprise the results of the match were announced at the evening banquet. Ted and his partner were too good for us.

Referring to other interests, the following has come to me from J. S. Ayars, Editor, Section of Publications, Natural History Survey Division:

"Dr. Frison's interest in Science did not prevent an appreciation of music, painting, American history, and world affairs. The love of music was held over from the years in which he played the violin and perhaps was inherited from his father, well known to early Champaign music lovers as a musician and teacher. World affairs he considered from the viewpoint of the biologist. Most of the Art Museums of the United States he visited in free time while on business trips. Spots famous in American history ranked with him in interest second only to the clear streams where stoneflies could be collected."

To his widow, son and daughter we extend our sincere sympathy.

ARTHUR GIBSON.

GUELPH PRINTING SERVICE

Mailed Wednesday, July 24, 1946.

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